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Pilot California Spiny Lobster Postlarvae Sampling Program: Collector Selection

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Lobster (infraorder Astacidea) is perhaps the most intensively studied shellfish around the world due to its economic importance (Phillips 2006). Fishery management tools almost universally include catch reporting, but fishery-dependent data such as this often fails to adequately inform managers about the true state of the population (Erisman et al. 2011). Increasingly, fishery-independent surveys are being relied upon to provide the robust information fishery managers require, such as the California Cooperative Oceanic Fisheries Investigation (CalCOFI). The CalCOFI program attempts to understand and predict variations in the Pacific Sardine (*Sardinops sagax*) fishery, among others, in California through quarterly sampling of fish larvae and other biological and hydrographic data. This focus on larval stages stems from Hjort's seminal work in 1914, which hypothesized the recruitment and transition of larval forms into postlarval and juvenile life stages is a critical period in population dynamics (Houde 2008). In modern times, fishery management agencies expend significant effort towards cataloging and understanding recruitment levels and patterns which provide the foundation for most fishery management tools (e.g. stock assessments).

Recruitment monitoring is at the core of many of global lobster fishery management programs (Cruz et al. 1995; Acosta et al. 1997; Cruz and Adriano 2001; Phillips et al. 2005; Phillips and Melville-Smith 2005; Phillips et al. 2006; Arteaga-Ríos et al. 2007; Phillips et al. 2010). Recruitment monitoring of numerous lobster taxa globally have been well correlated with future catch-rate predictions, typically with a 4 to 5 year time lag (e.g. Gardner et al. 2002; Caputi and Brown 2011; Linnane et al. 2014). Long-term recruitment monitoring programs, such as that in Australia (Linnane et al. 2010), are vital in assessing future stock levels and setting the total allowable commercial catches.

Like many lobster species, the California Spiny Lobster (*Panulirus interruptus*) is an economically important fishery species, supporting one of California's most valuable fisheries with annual ex-vessel values exceeding $9 million (Porzio et al. 2012). However, unlike many of the world's lobster fisheries, no California Spiny Lobster recruitment monitoring program exists. Recent attempts to address this data gap have been made using plankton collection (Koslow et al. 2012) and power plant entrapment records (Miller 2014). Plankton collections were unable to reliably predict recent landings while entrapment records were more successful, but both articles noted the likely effect of unknown recreational harvest levels impacting the analyses and final conclusions. While informative, neither existing program fulfills the need for targeted information on California Spiny Lobster recruitment in southern California. Furthermore, as southern California power plants shift away from once-through-cooling, lobster entrapment data may soon be unavailable, in which case no regular abundance estimates of California Spiny Lobster postlarvae will be available.

Noting the clear need for lobster recruitment monitoring in California, a pilot program was initiated in Orange County, California with the hopes of establishing a model that

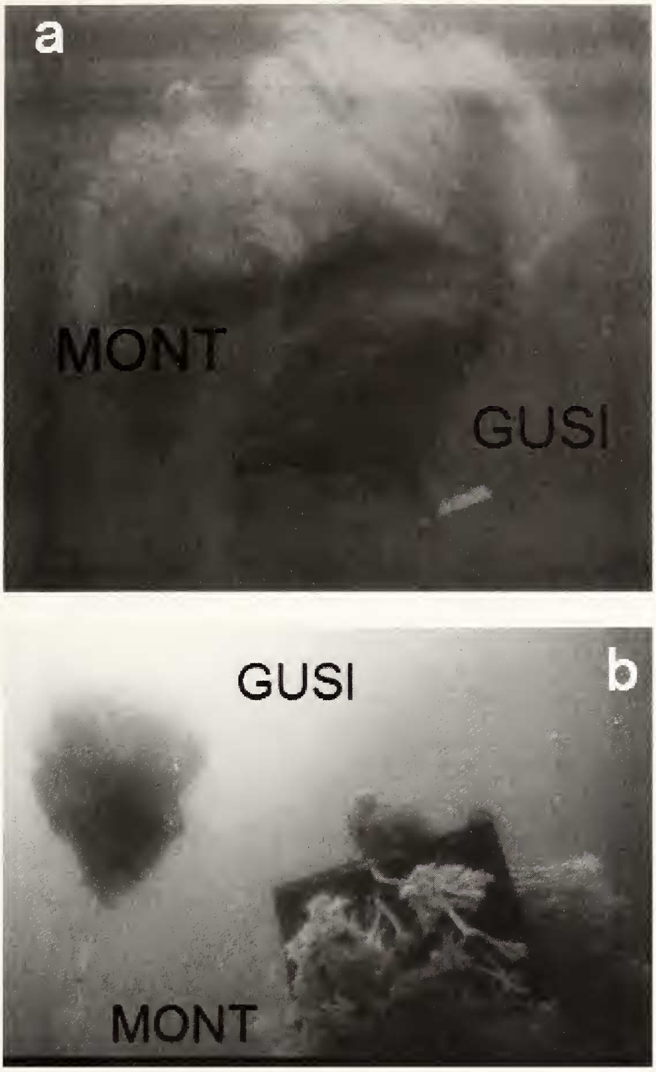

Fig. 1. Both GuSI and MONT type California Spiny Lobster postlarvae traps deployed at Abalone Point, California on 10 July 2013. a) GuSI in the forefront, b) MONT in the forefront.

could be expanded or replicated elsewhere in the state at minimal cost. Building upon the existing information on lobster recruitment monitoring elsewhere in the world, a pair of promising monitoring traps were identified for testing in southern California. Trap effectiveness varies greatly among different lobster species (Phillips and Booth 2008) thus it is important to compare the different trap types as done previously by Serfling and Ford (1974) and Phillips et al. (2001, 2005). Traps were chosen based on 1) likely cost, 2) likely ease of construction and use, and 3) reported effectiveness. Each trap design was modified slightly to maximize cost-effectiveness and ease of use. The first type (GuSI; Figure 1) was a modification of a design previously used in, among other places, Baja California, Mexico to successfully monitor postlarval California Spiny Lobster abundances (Arteaga-Ríos et al. 2007). The second type (MONT; Fig. 1) was a modification of a design used in Australia (Montgomery 2000).

Fig. 2. Postlarval California Spiny Lobster collected in a MONT traps offshore of Abalone Point Laguna Beach, California on 31 July 2013.

All materials used were purchased from at a local hardware store except marker buoys which were purchased at a local marine supply store. Total cost for each trap was less than $100. This fulfilled parts of two criteria, low cost and easy acquisition of materials for construction. The GuSI traps used were made by threading sisal rope through drilled holes in a plastic five-gallon bucket then covering the bucket in a burlap sack. Positive buoyancy resulted from lining the inside of the bucket with spray foam insulation. MONT traps were made by threading sisal rope through plastic peg board panels and connecting three panels together using plastic cable ties to form a triangle. A buoy was placed in the middle for buoyancy. In both cases, water motion frayed the sisal rope after deployment (Fig. 1). Refining the construction techniques as each trap was built resulted in a final estimated 1.0-1.5 hours to construct a trap of either design assuming the plastic pegboard panels were pre-cut to size.

One MONT and two GuSI traps were deployed on 10 July 2013 offshore of Abalone Point (33° 33.326N 117° 49.259W) on the coast of Laguna Beach, California at a depth of seven meters on sandy bottom habitat, with a rocky reef nearby and adjacent to a marine protected area. A second MONT trap and a third GUSI trap were deployed on 31 July

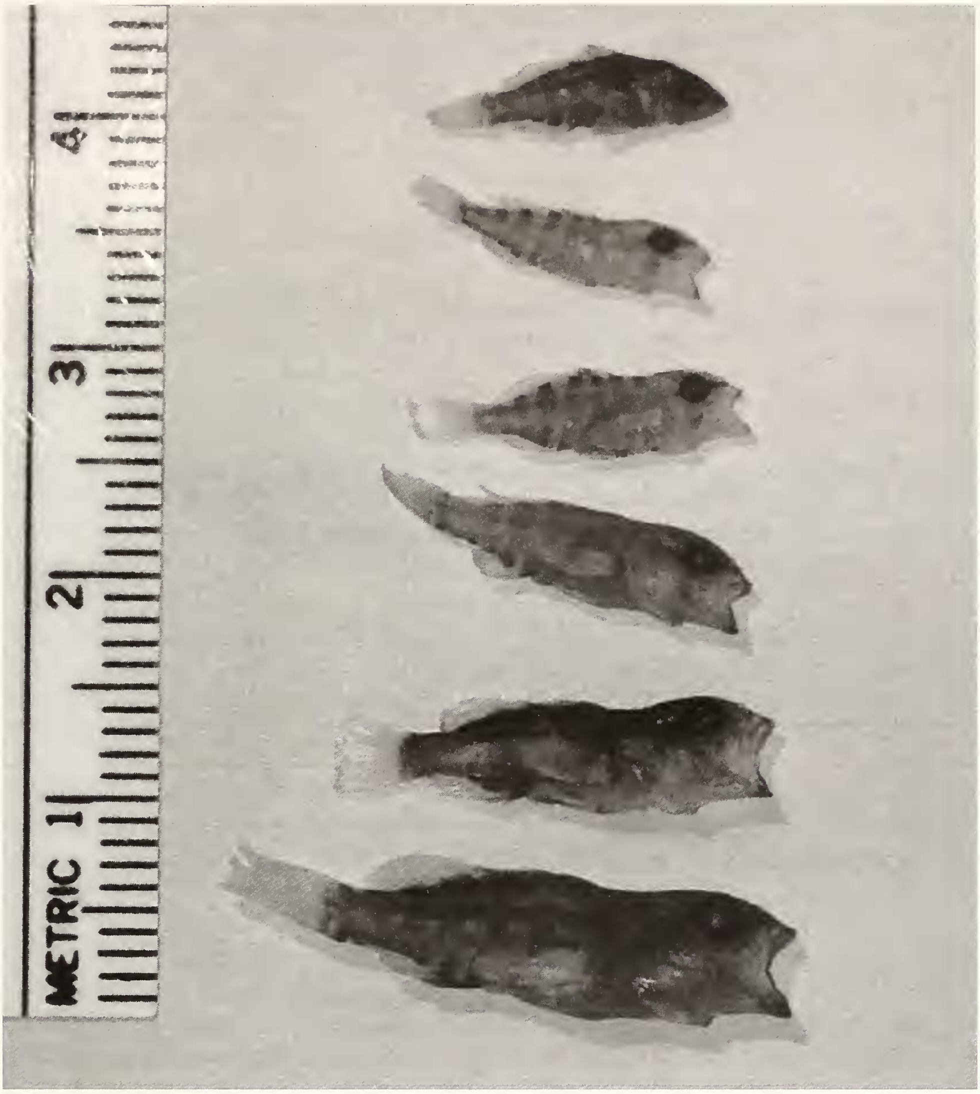

Fig. 3. Size series of postlarval Kelp Bass (*Paralabrax clathratus*) captured by a MONT trap set offshore of Corona del Mar in August 2013.

2013 and remained deployed through the last month of monitoring. Another trap string comprised of three MONT and one GuSI was deployed on 10 July 2013 just offshore of Corona del Mar, California in the lee of the Newport Bay jetty (33° 35.447N 117° 52.372W), but the three MONT traps were lost during a storm shortly after deployment. Two were recovered on the beach and the third was never found. Each of the recovered MONT traps was severely damaged, and two new MONT traps were deployed on the Corona del Mar string on 26 August to replace the lost traps.

On both the Abalone Point and Corona del Mar strings, the trap styles were alternated on each string so one design did not occur consecutively. Each trap was positively buoyant and remained at approximately one meter above the bottom with a mooring line attached to a communal anchor line. The communal anchor line was stretched between a

Table 1. Positive collections of California spiny lobster (Lobster), Kelp Bass, and all fish species combined (Total Fish) by service date, trap type, and location.

Date	# of Lobster	# Kelp bass	Total fish	Trap type	Location
7/31/2013	14	0	1	MONT	Abalone Point
8/26/2013	3	1	2	MONT	Abalone Point
8/26/2013	1	0	0	GuSI	Abalone Point
8/26/2013	2	0	0	GuSI	Abalone Point
8/26/2013	1	9	9	MONT	Corona del Mar
8/26/2013	2	5	6	MONT	Corona del Mar
9/26/2013	0	0	1	MONT	Abalone Point
9/26/2013	1	0	0	GuSI	Abalone Point
9/26/2013	0	0	1	GuSI	Abalone Point
Total	24	15	20		

Danforth anchor at the seaward end and a concrete block at the landward end, and a second concrete block was positioned at the midpoint for additional anchorage. The habitat was selected to minimize potential interference from natural habitat that may be preferred by the postlarvae (Montgomery 2000). No surfgrass (*Phyllospadix* spp.), believed to be the preferred California Spiny Lobster postlarval habitat (Barsky 2001) was in the immediate vicinity of the traps.

Servicing (inclusive of retrieval, sample collection, cleaning, and redeployment) occurred at nearly monthly intervals on 31 July and 26 August 2013. The final servicing, but not redeployment, occurred on 26 September 2013. No servicing occurred after the recreational fishery opened on 28 September 2013. Recovery was done by divers who cut the plastic cable ties connecting each trap to its mooring line. The traps were brought to the surface and taken aboard the boat where each trap was vigorously shaken 30 times while rotating the trap in a large trash can to remove individuals deeply embedded in the traps. Contents of the trash can were washed through a large, fine mesh (approximately 1 mm square mesh) aquarium net. The resulting sample was fixed in 4% seawater-buffered formalin in the field and transferred to 70% isopropanol after 72 hours in the fixative. Postlarval California Spiny Lobster (Fig. 2) and fish (Fig. 3) were sorted from the samples in the laboratory where they were enumerated, by species and by trap.

A total of nine MONT and 11 GuSI trap servicings were completed, which was analogous to a sample size of 20 traps for the purpose of this analysis. Eleven traps caught zero postlarval California Spiny Lobster. Nine positive catches were distributed amongst five MONT and four GuSI traps (Table 1). Standardizing the catch to the total sample size yielded 2.2 postlarval California Spiny Lobster/MONT trap and 0.4/GuSI trap. Twenty-one individuals were caught at Abalone Point while three were taken at Corona del Mar. Most of the MONT collection at Abalone Point occurred during the first deployment period when 14 individuals were taken. No postlarval individuals collected by the GuSI traps. Three postlarval individuals were caught by the GuSI traps and six in the MONT traps during the 26 August servicing. One individual was taken (GuSI) during the 26 September servicing at Abalone Point. The GuSI trap deployed at Corona del Mar never caught a postlarval individual.

The MONT traps also caught more recruiting fish (19 or 2.1/trap) than the GuSI traps (one or 0.1/trap). Corona del Mar MONT traps caught 15 of the 19 fish, including 14 Kelp Bass (*Paralabrax clathratus*). Furthermore, fouling communities developed on both designs at both locations, but the traps on the Corona del Mar string were also covered by filamentous algae. Fouling rates were not expressly examined during the course of this study and warrant further investigation in the future.

Both designs showed stress and damage after the three-month deployment. Most of the burlap was removed from the GuSI traps but they were otherwise intact. The plastic panels used in the MONT traps were extensively cracked in those that survived the whole deployment. Some broke as noted previously. None of the traps (GuSI or MONT) were deemed fit for redeployment for a second season. The strength of the MONT trap could be easily improved by using stronger perforated plastic panels, although this would likely raise the cost.

Ultimately, the success or failure of the trap design at catching postlarval California Spiny Lobster was the most important criteria in this evaluation. While the sample size was small and impacted by various factors, the MONT trap showed the most promise. Recommendations to this study plan would include earlier deployment of MONT traps constructed out of stronger (thicker) perforated plastic panels on the Abalone Point string. These refinements would build upon the lessons learned during the pilot program and help refine the methodology so it could later be deployed on a greater scale to better monitor California Spiny Lobster recruitment.

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